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The Role of Technological Tools in Managing Yacht Marinas: A Study of the Red Sea Coast

Fatma Mohammed [a] , **Mohammed Ezzat** [b], **Wafaa Ahmed Elias**[c],

[a] PhD Researcher, Tourism Studies Department, Faculty of Tourism and Hotels, Minia University

[b] Professor, Tourism Studies Department, Faculty of Tourism and Hotels, Minia University

[c] Professor, Tourism Studies Department, Faculty of Tourism and Hotels, Minia University

Keywords

Yacht Marinas, ICT, Digital Transformation, Marina Management, Security Systems, Operational Efficiency

Abstract

Abstract:

Yacht marinas play a crucial role in the maritime tourism, requiring efficient management systems to ensure smooth operations, enhance security, and improve the visitor experience. The integration of Information and Communication Technology (ICT) has transformed marina management, providing innovative solutions in security, reservation systems, and remote monitoring. This study aims to assess the adoption of ICT tools in yacht marina management along the Red Sea coast, focusing on the level of implementation, perceived benefits, and key challenges related to digital transformation. A structured questionnaire was distributed to 408 stakeholders, including yacht and boat owners, marina managers, captains and crew members, investors, and tourism professionals. The findings reveal that security systems and GPS tracking technologies are the most widely adopted, reflecting a priority for safety and vessel monitoring. However, maintenance management, environmental monitoring, and data analytics tools are underutilized, suggesting a gap in the use of smart technologies for long-term sustainability. While ICT contributes to improving operational efficiency, customer experience, and marketing strategies, barriers such as high implementation costs, lack of technical expertise, and resistance to technological change hinder full-scale adoption. The study concludes that while ICT has a transformative impact on marina operations, further investments are needed in staff training, cybersecurity, and cost-effective solutions for smaller marinas. Recommendations include improving digital literacy among marina staff,

subsidizing technology adoption for smaller operations, and integrating advanced environmental monitoring systems to enhance sustainability.

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1. Introduction

Smart technologies have attracted a lot of attention in the travel and tourism sector due to the quick development of information and communication technologies **(ICTS) (Atembe, 2015**). Marinas must be able to adapt to changing conditions by identifying an appropriate management strategy, as the number of marinas is rapidly growing. "Smart" means are becoming more appealing and competitive, which involves reducing waste of resources, time, money, and space that is, optimizing processes to maximize available resources with the least amount of effort **(Port Technology, 2016).**

Information and communication technology (ICT) has emerged as a significant component of the worldwide maritime industry **(Aung, 2009).** Many seaports have implemented ICT in terminal operations to increase productivity **(ITU, 2017).** A systematic integration of tourism and IT infrastructures can bring about ICT-driven tourism innovations **(Koo et al., 2017).** The ICT revolution has resulted in the development of numerous new tools for the tourism and hospitality sectors **(Dorcic et al., 2019).**

1.2. The Problem of the study:

Marinas are the most valuable part and starting points of nautical tourism development. There is a need to make them smarter due to emerging trends in new technology, systems, and solutions. They work to address functional and economic issues that affect their sustainability as they face mounting pressure to maximize their performance **(Molavi et al., 2020).** As a result, related problems with procedures, the environment, energy, safety, and security come up **(Bucak & Kuleyin, 2016).** Increased demand for nautical tourism leads to congestion since there are more vessels (particularly during peak season), which delays the arrival and departure of vessels at and from berths. If there is a lack of information sharing in the system, the marina management has to deal with operating errors (**Dragovic et al., 2016).** Therefore, there is a need to develop the methods used in the management of the Egyptian tourist marinas, which contributes to making operations more efficient, less costly and relying on the human element.

1.3. Objectives of the Study:

The study aims to achieve five main objectives:

1) Exploring the availability of information technology methods in the Egyptian tourist marinas.
2) Determining the different means of information technology applications used in each administrative and operational process in the Egyptian tourist marinas.
3) Shedding light on the problems facing tourists in the Egyptian tourist marinas when using information technology methods in the operations.
4) Presenting ideas and suggestions to solve the problems facing tourists in the Egyptian tourist marinas when using information technology methods.

1.4. Questions of the Study

1) What is the availability of information technology methods in the Egyptian tourist marinas?
2) What is the different means of information technology applications used in each administrative and operational process in the Egyptian tourist marinas?
3) What are the problems faced by the tourists in the Egyptian tourist marinas when using the methods of information technology in the operations?
4) How to solve the problems facing the tourists in the Egyptian tourist marinas when using the methods of information technology?

2. Literature Review

2.1. Technological Tools Used in Managing the Egyptian Yacht Marinas

The development of smart marinas necessitates the integration of infrastructure, work processes, and workers into a unique and complicated system that can collect data from all sources **(Hofmann et al., 2018).** To improve marina management, a cloud-based information and communications infrastructure is required **(Tan, 2018). Baker (2019)** reports that the following smart sensors are increasingly being used in marinas: Smart battery sensor, Smart heat sensor, Smart bilge sensor, Smart water sensor, Smart smoke sensor, Weather conditions sensor and Berth occupancy sensor.

Smart sensors allow for 24-hour monitoring and control of vessel conditions **(Krpetic, 2012).** When a safety issue is found, staff is notified quickly via email, phone call, and notification. Generating warnings enables marina staff to respond quickly, thereby preventing mishaps that could endanger the safety of customers, the environment, and the marina infrastructure.

Additionally, some marina management software offers docking assistance, automation of the check-in and check-out procedure, as well as the connection with power pedestals for controlling water and electricity consumption. These possibilities make it easier for boaters to access the marina and to plan their activities in the marina. Time saved can rather be spent using the facilities in the marina, which will increase the customers' satisfaction, as well as the service quality and the marina's

incomes. Monitoring of the available and occupied berths is still being done manually in most marinas. Using berth occupancy sensors, the marina staff can easily operate the marina via an on-screen map displaying the status of each berth; this optimizes the process of determining available berths for a certain vessel. Booking platforms streamline the process of identifying suitable berths for various types of vessels, allowing clients to manage their bookings and navigate to the booked berth. Several sensors with an emphasis on environmental sustainability have been developed thus far. Seawater level and quality sensors identify unlawful trash, fuel leaks, and other pollutants in the marina environment, and some also monitor energy use. Boaters typically struggle to secure an available berth during the peak season due to congestion and changing weather conditions. As a result, demand fluctuates since boats must occasionally adjust their course owing to inclement weather. Based on the boat's position and attributes, the software displays a real-time map of available berths at surrounding marinas. Weather sensors can assist boaters arrange their sails and management optimize capacity use **(Maglić et al., 2021).**

2.2. Advantages of Using Information and Communication Technology (ICT) in the Management of Tourist Marinas:

Using Information and Communication Technology (ICT) in the management of tourist marinas offers several advantages that enhance operational efficiency, improve the visitor experience, and contribute to sustainable development. These benefits can be categorized into key areas:

1. **Enhanced Customer Experience:**
   ICT provides real-time information about marina services and available berths, ensuring tourists are well-informed **(Dinis et al., 2019).** Automated online booking systems allow for easy reservation of berths, improving convenience for visitors **(Schröder et al., 2020).**
2. **Operational Efficiency:**
   ICT tools help with better resource management, improving inventory tracking and overall operations **(Baker et al., 2018).** Additionally, advanced data analytics can offer valuable insights into usage patterns and peak times, allowing marinas to optimize operations **(Prabha & Suresh, 2020).**
3. **Marketing and Promotion:**
   Digital marketing strategies, such as social media and online advertising, enable marinas to reach a broader audience and attract more visitors **(Leung et al., 2013).** ICT platforms also facilitate the collection of customer feedback, helping marinas improve their services **(Sigala, 2018).**
4. **Sustainability Initiatives:**
   Environmental monitoring tools powered by ICT can track various environmental factors, promoting eco-friendly practices within marinas **(Pereira et al., 2019).** The integration of smart technologies like IoT sensors can optimize energy consumption and resource management, contributing to the sustainability of marina operations **(Wang et al., 2021).**
5. **Improved Communication:**
   ICT enhances communication between marina operators, local authorities, and tourists, fostering better collaboration and governance **(Santos et al., 2021).**

Moreover, it supports effective emergency management through streamlined communication channels, improving response times during crises **(González et al., 2020).**

6. **Cost Reduction:**
   Automation of various processes can significantly reduce operational costs, minimize human error, and improve overall efficiency **(Zhou & Wang, 2020).** Furthermore, ICT-driven predictive maintenance can reduce downtime and maintenance costs by identifying potential issues before they arise **(Nguyen et al., 2021).**

2.3. Challenges and Problems Facing the Use of ICT in the Management of Tourist Marinas

These challenges can range from technical issues and security concerns to the cost of implementation and the training of personnel. Below are some of the key challenges facing the use of ICT in the management of tourist marinas:

1. **High Initial Costs and Maintenance Expenses**
   The initial investment required to adopt ICT solutions can be significant **(Schröder et al., 2020**). Furthermore, ICT systems require continuous updates and maintenance to remain functional and secure, which incurs ongoing maintenance and upgrading costs **(Dinis et al., 2019).**
2. **Cybersecurity Threats**
   With the increasing reliance on online booking systems and customer databases, marinas face the risk of cyber-attacks, raising serious concerns over data security **(Baker et al., 2018).** To safeguard against these threats, marinas must invest in robust cybersecurity infrastructure, such as firewalls, encryption technologies, and data protection protocols **(Harrigan et al., 2015).**
3. **Limited Technological Expertise**
   Many marinas, especially those in smaller or more remote areas, face a shortage of personnel with the necessary ICT skills to operate, manage, and troubleshoot these systems **(Prabha & Suresh, 2020)**. Even when ICT systems are in place, staff must be adequately trained to use them effectively **(Sigala, 2018).**
4. **Resistance to Change**
   Some marina operators or staff may resist adopting ICT solutions due to a lack of understanding or familiarity with technology **(Leung et al., 2013).** There is also the fear that the increasing use of automated systems, such as online booking and customer service chatbots, may lead to job displacement **(Buhalis & Law, 2008).**
5. **Connectivity Issues**
   Many marinas are located in remote or rural areas where internet connectivity is unreliable or slow **(Schröder et al., 2020).** ICT systems also depend on reliable internet connections, electrical power, and technological infrastructure, which can be a challenge in certain locations **(Prabha & Suresh, 2020).**
6. **Integration Issues**
   Many marinas use a variety of ICT systems for different purposes, such as booking, CRM, and facility management. Integrating these multiple systems can be difficult **(Baker et al., 2018).** Additionally, the absence of industry-wide standards for marina management software complicates the integration of ICT systems across different marinas **(Dinis et al., 2019).**

7. **Customer Adaptation Issues**
   Not all customers may be comfortable using ICT tools such as online booking systems or mobile apps **(Leung et al., 2013).** Moreover, as marinas adopt more ICT solutions, customers may expect higher levels of digital convenience, such as seamless online transactions and real-time service updates **(Buhalis & Law, 2008).**
8. **Data Management and Privacy Concerns**
   As marinas collect more customer data through ICT systems, managing and analyzing this data effectively becomes increasingly challenging **(Harrigan et al., 2015).** Additionally, marinas must comply with data protection regulations such as the General Data Protection Regulation (GDPR) in the EU, which requires secure handling of personal data **(Dinis et al., 2019).**
9. **Cost-Benefit Imbalance for Small Marinas**
   Small and independent marinas may not see immediate benefits from adopting expensive ICT solutions, especially when their customer base is limited **(Prabha & Suresh, 2020**). Moreover, scaling ICT systems to fit the limited resources of small marinas can be both difficult and costly. Customizing large-scale ICT solutions to meet their needs may not be efficient **(Buhalis & Law, 2008).**
10. **Technological Obsolescence**
    The rapid pace of technological advancements means that ICT systems can quickly become outdated **(Schröder et al., 2020).** Some marinas may also become dependent on specific ICT vendors or software platforms, leading to the risk of vendor lock-in **(Baker et al., 2018).**

3. 3. Research Methodology

This study adopts a quantitative research approach to examine the role of Information and Communication Technology (ICT) in managing yacht marinas. The research follows a descriptive and analytical design, aiming to analyze the role of (ICT) in the management of tourist marinas along the Red Sea coast, by studying the extent of integration of these technologies in administrative and operational processes. ,evaluating the level of adoption of ICT in tourist marinas, by measuring the extent of use of these technologies by different departments, and identifying the factors influencing their adoption, identifying the benefits resulting from the application of ICT in the management of tourist marinas, such as improving the efficiency of operations, enhancing the user experience, and facilitating data-based decision-making, exploring the challenges associated with the application of ICT, whether technical, financial, administrative, or human, and analyzing their impact on the success of the digital transformation process and providing recommendations to enhance the use of ICT in tourist marinas, by proposing solutions to overcome obstacles and maximize the benefits of these technologies.

3.1. Data Collection

The sample size for this study was determined using a combination of statistical methods to ensure representativeness and accuracy. Given the study's focus on yacht marinas along the Red Sea coast, a structured approach was used to

determine the appropriate sample size. Cochran's formula was applied, as it is widely used for large populations, ensuring that the sample adequately reflects the target group. Additionally, Slovin's formula was considered to adjust the sample size based on the total population and margin of error. A confidence level of 95% and a margin of error of 5% were used to enhance statistical reliability. Krejcie and Morgan's sample size table was also referenced to validate the final number. Based on these methods, 408 questionnaires were distributed to various stakeholders, including tourists, yacht renters, marina operators, and tourism professionals, ensuring a diverse and representative sample for the study. The questionnaire was designed to cover key areas such as:

- The types of technological tools used in marina management.
- The extent of ICT adoption across different operational stages.
- The perceived benefits and challenges of ICT integration.
- The relationship between demographic factors and ICT usage in marinas.

3.2. Data Analysis

The collected data were analyzed using SPSS Version 24, employing both descriptive and inferential statistical methods to derive meaningful insights. The analysis involved:

- Descriptive Statistics (frequencies, percentages, mean, and standard deviation) to summarize the characteristics of respondents and their perceptions of ICT.
- Chi-Square Tests to examine associations between categorical variables, such as occupation and ICT usage or age and ICT adoption.
- Pearson Correlation Analysis to measure relationships between ICT awareness, perceived benefits, and operational efficiency.

This research design ensures a systematic and data-driven approach, providing empirical evidence on the impact of ICT on yacht marina operations while identifying key opportunities and challenges in digital transformation within the maritime tourism sector.

3.2.1. Questionnaire Design

The questionnaire Considered one of the most widely used data collection methods within the strategy of survey **(Saunders et al., 2009).** According to **Kirklees Council (2014)** a questionnaire is a tool to collect and record information about a specific issue of importance and most of it made up of a list of questions**.**

The in this study was designed to assess the role of technological tools in managing yacht marinas along the Red Sea coast, focusing on the extent of their adoption, perceived benefits, and challenges associated with their implementation. It

was structured into multiple sections to ensure a comprehensive evaluation of ICT usage in marinas, from the types of digital tools employed to their impact on operational efficiency. The questionnaire included **closed-ended questions** using a **five-point Likert scale** to measure participants' perceptions of ICT adoption and its effectiveness in marina management. Additionally, demographic data such as **nationality, age, gender, occupation, and education level** were collected to analyze how different respondent profiles influence technology adoption.

The survey also explored the **most commonly used technological tools** in marina operations, including **security and surveillance systems, electronic reservation systems, remote control technologies, and marina management software**. Respondents were asked to evaluate the extent to which these technologies are integrated into daily marina operations and how they contribute to overall efficiency. Furthermore, the questionnaire examined the **key benefits of ICT in marina management**, such as **enhancing operational efficiency, improving safety measures, reducing costs, and optimizing customer experience**, highlighting the most significant perceived advantages.

Another critical aspect of the questionnaire focused on **the challenges faced in ICT adoption**, including **high implementation and maintenance costs, lack of technical expertise, the need for continuous updates, and resistance to change among staff**. Lastly, participants were asked to assess the **effectiveness of problem-solving efforts** in overcoming these challenges, indicating whether issues related to ICT implementation had been **fully resolved, partially addressed, or remained unresolved**. The reliability and validity of the questionnaire were ensured through **Cronbach's Alpha coefficient**, measuring internal consistency, and a **pilot study** conducted before full distribution to enhance clarity and effectiveness. This structured questionnaire provided a **comprehensive and data-driven assessment** of technological adoption in yacht marinas, offering valuable insights into its impact on efficiency, security, and management practices.

3.3. Validity and Reliability

Gamal (2018) claimed that the reliability and validity of the researchers' results were important to their research's credibility and performance.

- Cronbach's Alpha coefficient was calculated to ensure the questionnaire's internal consistency and reliability.
- A pilot study was conducted before full distribution to enhance clarity and accuracy in measuring ICT adoption and its effects.

This questionnaire structure ensured a comprehensive assessment of ICT tools in yacht marina management, allowing for a data-driven evaluation of their effectiveness, challenges, and potential improvements.

3.3.1. Data Reliability

To evaluate the internal consistency of the questionnaire, Cronbach's alpha coefficient was calculated. As noted by **Döckel (2003)**, a Cronbach's alpha value of 0.7 or higher is deemed "acceptable" in most social science research contexts **(Nunnally, 1978)**. For this study, Cronbach's alpha reliability was calculated for key sections of the questionnaire, yielding a high reliability value of 0.881 and accuracy coefficients of 0.938, as illustrated in **Table (1).** These results confirm the instrument's utility and reliability for data collection.

Table (1): Cronbach's Alpha Value

Variables	No. of items	Reliability coefficient	Validity Coefficient*
The technological tools used in the management of tourist marinas	16	0.777	0.882
Stages is ICT most used in the management of tourist marinas	7	0.819	0.905
The key benefits of using ICT in yacht marina management	6	0. .847	0.920
The challenges have you encountered while using ICT in yacht marina management	13	0.737	0.859

*** Validity coefficient = √Reliability coefficient**

The reliability analysis using **Cronbach's alpha** confirmed that the questionnaire used in this study demonstrated strong internal consistency, with values ranging from **0.737 to 0.847**, all exceeding the acceptable threshold of **0.7**. The highest reliability was found in the section measuring **the benefits of ICT in marina management (0.847)**, indicating stable responses regarding its advantages. Similarly, **ICT usage stages (0.819)** and **technological tools in marina management (0.777)** showed high reliability, confirming the consistency of responses about technology adoption. The **challenges of ICT adoption (0.737)** had slightly lower reliability, suggesting some variation in respondents' experiences with obstacles such as **high costs and lack of expertise**. However, the overall **validity coefficient above 90%** affirms that the questionnaire was well-structured and effectively captured the intended research variables, ensuring the reliability of the collected data for further analysis.

4. Results and Discussion

Section one: Demographic characteristics of respondents

The table (2) illustrates the distribution of survey respondents based on their nationality, categorized into five main regions: Middle East & North Africa, Europe, Americas & Oceania, UK & English-Speaking Countries, and Other.

- European respondents constitute the largest segment at 45%, indicating a strong presence of tourists or stakeholders from this region in the study.
- Middle East & North Africa respondents make up 17%, reflecting a significant local or regional interest.

- Americas & Oceania account for 14%, showing moderate representation from these regions.
- UK & English-Speaking Countries contribute 12%, suggesting a relatively smaller yet relevant share of participants.
- The remaining 12% falls under the other category, indicating a diverse mix of nationalities that do not fit into the predefined classifications.

This distribution suggests that European tourists or professionals play a dominant role in the studied context, potentially influencing the trends and technological adoption in yacht marina management. The diversity in responses provides a well-rounded perspective, enhancing the study's validity in understanding global patterns in this sector.

Table (2): the distribution of survey respondents based on their nationality

Nationality	Frequency	Percent
Middle East & North Africa	72	17.6
Europe	184	45.1
Americas & Oceania	56	13.7
UK & English-Speaking Countries	48	11.8
Other	48	11.8
Total	408	100.0

The table (3) presents the age distribution of the survey respondents, divided into four categories:

- 41 to 60 years represents the largest group at 42.9%, indicating that middle-aged individuals are the most dominant participants in the study.
- 20 to 40 years follows closely at 39.5%, suggesting that younger professionals and tourists also form a significant portion of the respondents.
- More than 60 years accounts for 11.8%, showing a lower but notable presence of older individuals in the surveyed population.
- 20 years or less is the least represented group at 5.9%, implying minimal participation from younger age groups.

This distribution highlights that the majority of respondents belong to the 41-60 and 20-40 age groups, which could suggest that yacht marina activities and technology adoption are most relevant to individuals in their professional and middle-age years. The relatively lower percentage of younger and older participants may indicate either limited engagement in the sector or specific preferences in maritime tourism and management.

Table (3): the age distribution of the survey respondents.

Age	Frequency	Percent
20 years or less	24	5.9
From 20 to 40 years	161	39.5
41 to 60 years	175	42.9
More than 60 years	48	11.8
Total	408	100.0

The table (4) illustrates the gender distribution of the survey respondents:

- Males constitute 64% of the sample, indicating a dominant presence of male participants in the study.
- Females represent 36%, showing a lower but still significant proportion of female respondents.

This distribution suggests that male participants are more engaged in activities related to yacht marinas on the Red Sea coast, whether as tourists, employees, or stakeholders. The lower female participation could reflect industry-specific dynamics, travel preferences, or occupational roles in the sector.

Table (4): the gender distribution of the survey respondents

Gender	Frequency	Percent
Male	263	64.5
Female	145	35.5
Total	408	100.0

The table (5) illustrates the occupational distribution of respondents engaged in yacht marina activities along the Red Sea coast. The results indicate:

- Tourists and yacht renters (41.2%) form the largest group, reflecting the primary role of marinas in catering to leisure and tourism.
- Yacht and boat owners (23.5%) represent a significant proportion, highlighting the presence of private ownership and maritime enthusiasts.
- Captains and yacht crew (17.6%) also constitute a notable share, emphasizing the importance of operational roles in the sector.
- Investors and business owners in marine tourism (9.8%) comprise a smaller but essential segment, demonstrating financial interest and entrepreneurship in the industry.
- Media professionals and tourism bloggers (7.8%) have the lowest representation, suggesting a relatively limited but still relevant role in promoting and documenting the sector.

Table (5): the occupational distribution of respondents

Occupation	Frequency	Percent
Yacht and Boat Owners	96	23.5
Captains and Yacht Crew	72	17.6
Tourists and Yacht Renters	168	41.2
Investors and Business Owners in Marine Tourism	40	9.8
Media Professionals and Tourism Bloggers	32	7.8
Total	**408**	**100.0**

The table (6) presents the educational background of respondents involved in marine tourism activities. The distribution reveals:

- Higher Education (Bachelor's degree) (53%) constitutes the majority, indicating that most respondents have an academic background relevant to the industry.
- MSc/PhD holders (33%) represent a significant proportion, reflecting a highly educated group involved in yacht-related tourism, possibly in managerial, research, or specialized roles.
- Postgraduate Diploma holders (10%) demonstrate an intermediate level of academic advancement, suggesting further specialization beyond undergraduate studies.
- High School or below (4%) forms the smallest segment, indicating that most individuals engaged in this sector have pursued higher education.

This distribution suggests that the marine tourism sector attracts a highly educated workforce, which may contribute to professional service standards and industry development.

Table (6): the educational background of respondents

Educational level	Frequency	Percent
High School or below	16	3.9
Higher Education (Bachelor's degree)	216	52.9
Postgraduate Diploma	40	9.8
MSc / PhD	136	33.3
Total	**408**	**100.0**

Section two:

1) Assessing Technological Tools Used in Managing the Egyptian Yacht Marinas

Table (7) Technological Tools Used in Managing the Egyptian Yacht Marinas

Technological Tool	1%	2%	3%	4%	5%	Mean	SD	Rank	Attitude
Security and alarm systems	0	0	7.8	35.3	56.9	4.49	.639	1	**Strongly Agree**
Power and fuel monitoring systems	0	0	13.7	47.1	39.2	4.25	.682	4	**Strongly Agree**
Remote control systems	3.9	2.0	5.9	37.3	51.0	4.29	.957	3	**Strongly Agree**
Reservation management systems	0	3.9	13.7	45.1	37.3	4.16	.802	6	**Agree**
Wired and wireless communication systems.	2.0	3.9	13.5	45.1	35.5	4.08	.905	9	**Agree**
Weather and sea monitoring system	3.9	3.9	19.6	33.1	39.5	4.00	1.050	10	**Agree**
Inventory tracking and management systems	5.9	9.8	33.3	29.4	21.6	3.51	1.111	15	**Agree**
Maintenance and service management systems	3.9	25.7	35.0	19.6	15.7	3.17	1.100	16	**Neutral**
Mobile Apps	3.9	2.0	9.8	45.3	39.0	4.13	.950	7	**Agree**
Automated Access Control Systems	2.0	2.0	15.7	37.0	43.4	4.18	.903	5	**Agree**
E-marketing tools and systems	3.9	0	17.9	58.6	19.6	3.90	.848	12	**Agree**
Electronic Customer relationship management systems	0	3.9	23.5	49.0	23.5	3.92	.789	11	**Agree**
Marina Management Software	3.9	15.7	29.4	27.2	23.8	3.51	1.130	13	**Agree**
RFID Technology	0	7.8	21.6	43.1	27.5	3.90	.892	14	**Agree**
CCTV Systems	2.0	0	23.5	35.3	39.2	4.10	.892	8	**Agree**
GPS tracking systems	0	3.9	11.8	31.6	52.7	4.33	.833	2	**Strongly Agree**
Total mean	**4.00**								**Agree**

The table (7) presents the evaluation of technological tools used in managing Egyptian yacht marinas along the Red Sea coast. The results are analyzed based on mean scores, standard deviation, ranking, and Likert scale interpretation.

Key Findings

1. Overall Attitude Towards Technological Tools
   - The total mean score is 4.00, indicating an overall “Agree” response.

- This suggests that respondents generally acknowledge the importance and utilization of technological tools in yacht marina management.

2. Technological Tools with the Highest Agreement ("Strongly Agree")
   - Security and alarm systems (4.49, SD = 0.639) ranked the highest, showing strong agreement on its significance in marina operations.
   - GPS tracking systems (4.33, SD = 0.833) also received a high score, emphasizing its essential role in navigation and safety.
   - Remote control systems (4.29, SD = 0.957) and power & fuel monitoring systems (4.25, SD = 0.682) were also highly rated.
   - The strong agreement on these tools highlights their critical role in ensuring security, efficiency, and automation in marina management.
3. Technological Tools with Moderate Agreement ("Agree")
   - Several tools scored within the 4.00 – 4.18 range, indicating a strong but slightly lower level of agreement compared to the top-ranked technologies.
   - These include reservation management systems (4.16), mobile apps (4.13), CCTV systems (4.10), and RFID technology (3.90), suggesting they are widely used but not as crucial as security and tracking tools.
   - E-marketing tools (3.90) and customer relationship management (CRM) systems (3.92) indicate that while marketing technologies are applied, they may not be prioritized as much as security and operational tools.
4. Technological Tools with the Lowest Agreement ("Neutral" or Low "Agree")
   - Maintenance and service management systems (3.17, SD = 1.100) received the lowest mean score, suggesting that respondents are either unsure about its effectiveness or it is not widely adopted.
   - Inventory tracking and management systems (3.51, SD = 1.111) and Marina Management Software (3.51, SD = 1.130) also received relatively lower scores, indicating potential gaps in implementation or awareness.

Insights and Implications

The results suggest that security, navigation, and operational control technologies are prioritized in yacht marinas, while marketing and customer relationship tools are moderately used Technologies related to maintenance, service management, and inventory tracking appear to be less emphasized, which may indicate an opportunity for improvement in marina operations The high standard deviations (e.g., 1.111 for inventory tracking and 1.130 for marina management software) indicate variation in responses, suggesting differences in adoption levels across different marinas.

This result supported the second question of the study, and also achieved the second objective of this study, i.e.,: Determining the different means of information technology applications used in each administrative and operational process in the Egyptian tourist marinas.

2) At which stages is information and communication technologies (ICT) most used in the management of tourist marinas?

Table (8) the stages where ICT is most used in managing tourist marinas.

Stage	1%	2%	3%	4%	5%	Mean	SD	Rank	Attitude
Infrastructure Management and Maintenance	25.5	19.6	29.4	13.7	11.8	2.67	1.310	7	**Disagree**
Customer Relationship and Marketing	0	2.0	17.6	35.3	45.1	4.24	.808	1	**Agree**
Day-to-Day Operations Management	2.0	3.9	21.8	37.0	35.3	4.00	.952	3	**Agree**
Environmental Monitoring and Sustainability	7.8	41.2	29.4	15.7	5.9	2.71	1.017	6	**Disagree**
Security and Safety Management	0	3.9	19.6	29.4	47.1	4.20	.887	2	**Agree**
Post-Visit Engagement and Feedback Collection	2.0	9.8	37.5	25.2	25.5	3.63	1.030	5	**Agree**
Planning and Development Stage	2.0	12.0	33.1	41.2	11.8	3.49	.919	1	**Neutral**
Total mean	**3.56**								**Agree**

The table (8) presents respondents' evaluations of the stages where ICT is most used in managing tourist marinas. The analysis is based on mean scores, standard deviation, ranking, and Likert scale classification.

Key Findings

1. Overall Attitude Towards ICT Usage Across Different Stages
   - The total mean score is 3.56, indicating an overall “Agree” response.
   - This suggests that respondents acknowledge the role of ICT in various marina management stages, but the level of implementation varies across different functions.
2. Stages with the Highest ICT Usage ("Agree")
   - Customer Relationship and Marketing (Mean = 4.24, SD = 0.808) ranked the highest, indicating that ICT is widely applied in managing customer interactions, marketing campaigns, and digital engagement.
   - Security and Safety Management (Mean = 4.20, SD = 0.887) also received strong agreement, reflecting the importance of digital surveillance, alarm systems, and access control technologies in marinas.
   - Day-to-Day Operations Management (Mean = 4.00, SD = 0.952) suggests that ICT is effectively integrated into daily marina activities, such as scheduling, reservations, and service management.
3. Moderately Used ICT Stages ("Neutral")
   - Planning and Development Stage (Mean = 3.49, SD = 0.919) indicates that ICT tools are used to some extent in strategic and long-term decision-making, but not as extensively as in customer-related functions.

- Post-Visit Engagement and Feedback Collection (Mean = 3.63, SD = 1.030) suggests that while ICT is used for collecting visitor feedback and follow-ups, it is not a top priority compared to marketing and security.

4. Stages with the Lowest ICT Usage ("Disagree")
   - Infrastructure Management and Maintenance (Mean = 2.67, SD = 1.310) received the lowest score, indicating that ICT is not widely utilized in this stage, possibly due to reliance on manual operations or traditional management approaches.
   - Environmental Monitoring and Sustainability (Mean = 2.71, SD = 1.017) also scored low, suggesting that ICT adoption in tracking environmental impact, water quality, and sustainability initiatives is still limited.

Insights and Implications

The results highlight that ICT is most widely used in customer management, marketing, and security, reflecting the sector's priorities in enhancing visitor experience and safety The limited adoption of ICT in infrastructure maintenance and environmental sustainability suggests an opportunity for improvement, especially with the rise of smart technologies in sustainable tourism The high standard deviations (e.g., 1.310 for infrastructure management) indicate variability in responses, suggesting that some marinas may already be integrating ICT, while others still rely on traditional methods.

3) What are the key benefits of using ICT in yacht marina management?

Table (9) benefits of using ICT in yacht marina management.

Benefit	1%	2%	3%	4%	5%	Mean	SD	Rank	Attitude
Operational Efficiency	2.0	0	7.8	33.3	56.9	4.43	.799	1	**Strongly Agree**
Marketing and Promotion	.5	.5	15.4	60.8	19.9	4.02	.656	3	**Agree**
Sustainability Initiatives	15.7	31.4	25.5	17.6	9.8	2.75	1.203	5	**Neutral**
Improved Communication	3.9	0	17.6	45.3	33.1	4.04	.928	2	**Agree**
Cost Reduction	19.6	41.2	17.6	11.8	9.8	2.51	1.212	6	**Neutral**
Enhanced Customer Experience	0	11.5	19.6	35.5	33.3	3.91	.992	4	**Agree**
Total mean	**3.60**								**Agree**

The table (9) presents respondents' evaluations of the key benefits of using ICT in yacht marina management. The analysis is based on mean scores, standard deviation, ranking, and Likert scale classification.

The findings indicate that respondents generally recognize the benefits of ICT in marina management, particularly in enhancing **operational efficiency, marketing, and communication**. ICT is most valued for **automating operations, reducing errors, and improving coordination** between marina stakeholders. It also plays a key role in **digital marketing and customer engagement**, contributing to better visitor experiences. However, **sustainability and cost reduction** were perceived as **less significant benefits**, suggesting that ICT adoption in these areas remains limited. The variability in responses highlights differences in technology implementation

across marinas, emphasizing the need for greater awareness and investment in eco-friendly and cost-saving ICT solutions

4) What challenges have you encountered while using ICT in yacht marina management?

Table (10) challenges encountered while using ICT in yacht marina management.

Challenge	1%	2%	3%	4%	5%	Mean	SD	Rank	Attitude
Securing communications and wireless networks on board yachts	62.7	19.4	11.8	2.2	3.9	1.65	1.033	13	**Strongly Disagree**
Data Management and Privacy	43.1	39.2	9.6	8.1	0	1.83	.907	12	**Disagree**
Connectivity Issues	19.4	27.5	39.5	11.8	2.0	2.50	.996	9	**Neutral**
Limited Technological Expertise	0	2.0	25.7	37.0	35.3	4.06	.829	1	**Agree**
High Initial Costs and Maintenance Expenses	2.0	3.9	29.4	41.4	23.3	3.80	.907	2	**Agree**
Protecting monitoring data and privacy from leaks	33.3	35.3	17.6	11.8	2.0	2.14	1.068	11	**Disagree**
Ensuring the stability and security of remote monitoring and control systems.	29.4	39.2	19.6	7.8	3.9	2.18	1.062	10	**Disagree**
Regularly updating technology to keep pace with developments and security threats	5.9	15.9	15.4	21.6	41.2	3.76	1.296	3	**Agree**
Training teams to use and understand technology effectively	9.8	10.0	13.7	33.3	33.1	3.70	1.291	4	**Agree**
Resistance to Change	14.0	13.7	43.1	19.6	9.6	2.97	1.130	7	**Neutral**
Customer Adaptation Issues	15.7	12.0	45.1	19.6	7.6	2.91	1.115	8	**Neutral**
Cost-Benefit Imbalance for Small Marina	11.8	11.8	23.5	21.6	31.4	3.49	1.350	6	**Agree**
Technological Obsolescence	3.9	13.7	23.5	27.7	31.1	3.68	1.163	5	**Agree**
Total mean	**2.97**								**Neutral**

The table (10) presents respondents' evaluations of challenges encountered while using ICT in yacht marina management. The analysis is based on mean scores, standard deviation, ranking, and Likert scale classification.

Key Findings

1. Overall Perception of ICT Challenges
   - The total mean score is 2.97, indicating an overall “Neutral” response.
   - This suggests that while some ICT challenges are significant, others are not widely perceived as problematic by respondents.
2. Least Concerning Challenges ("Strongly Disagree" or "Disagree")
   - Securing communications and wireless networks (Mean = 1.65, SD = 1.033) received the lowest rating, with 62.7% strongly disagreeing that this is a major issue. This suggests that marinas may already have effective security measures in place for communication networks.

- Data management and privacy concerns (Mean = 1.83, SD = 0.907) were also perceived as not a major challenge, likely due to existing data protection practices.
- Protecting monitoring data from leaks (Mean = 2.14, SD = 1.068) and ensuring the stability and security of remote monitoring systems (Mean = 2.18, SD = 1.062) were rated low, indicating that respondents feel these challenges are either well-managed or not highly relevant.

3. Major Challenges ("Agree")
   - Limited technological expertise (Mean = 4.06, SD = 0.829) ranked the highest, with over 70% of respondents agreeing that lack of technical skills is a major barrier to ICT adoption in marinas.
   - High initial costs and maintenance expenses (Mean = 3.80, SD = 0.907) were also seen as a challenge, suggesting that investment in ICT infrastructure is perceived as expensive.
   - Keeping up with technological developments and security threats (Mean = 3.76, SD = 1.296) highlights concerns about the rapid evolution of technology and the need for constant updates.
   - Training teams to effectively use ICT (Mean = 3.70, SD = 1.291) was another notable challenge, suggesting a need for more training programs and capacity-building initiatives.
   - Technological obsolescence (Mean = 3.68, SD = 1.163) indicates that respondents recognize the risk of ICT solutions becoming outdated, necessitating continuous upgrades.
4. Moderate Challenges ("Neutral")
   - Resistance to change (Mean = 2.97, SD = 1.130) and customer adaptation issues (Mean = 2.91, SD = 1.115) indicate mixed responses, suggesting that some stakeholders struggle with adopting ICT, while others do not find it an issue.
   - Cost-benefit imbalance for small marinas (Mean = 3.49, SD = 1.350) suggests that smaller marinas might find ICT adoption less cost-effective compared to larger ones.

Insights and Implications

Technical expertise and training gaps are the most critical challenges, emphasizing the need for capacity-building programs High costs and the need for frequent updates present financial and operational barriers to ICT adoption Marinas with smaller budgets may struggle more, indicating a potential need for government incentives or industry support programs to promote ICT implementation Security and privacy issues are not considered major concerns, suggesting sufficient existing protective measures.

This result supported the third question of the study, and also achieved the third objective of this study, i.e., shedding light on the problems facing tourists in the Egyptian tourist marinas when using information technology methods in the operations.

5) How likely the problems you met when you used ICT are solved?

Table (11) the problems which met the tourists and to what extend it solved

Not solved	Partly solved	Completely solved	Mean	SD	Attitude
19.6	35.3	45.1	2.25	.764	Completely solved

The findings suggest that most ICT-related challenges in yacht marina management have been successfully resolved, particularly in **security, privacy, and basic operations**. Nearly half of the respondents believe these issues are **completely solved**, while others indicate that **cost barriers and training gaps** still require attention. Only a small percentage reported **unresolved challenges**, reflecting **positive progress in ICT integration**. However, further efforts in **staff training and cost reduction strategies** are needed to address remaining concerns. Future research could explore how **occupational roles and experience levels influence perceptions of ICT problem resolution**.

Chi-Square Test

This part shows the relations between some important variables in the field study by cross tabulations, it also shows the significance differences between some of these variables with use chi-square test, and find in these part correlations between the variables of the study.

Table (12) Occupation & ICT Usage

Chi-Square Tests			
	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	446.223a	52	.000
Likelihood Ratio	443.613	52	.000
Linear-by-Linear Association	1.191	1	.275
N of Valid Cases	408		
a. 41 cells (58.6%) have expected count less than 5. The minimum expected count is .63.			

The Chi-Square test was conducted to examine the relationship between **occupation and ICT usage in yacht marina management**. The results indicate a **statistically significant association** ($\chi^2 = 446.223$, **df = 52, p = 0.000**), meaning that ICT usage varies across different occupational groups, such as yacht and boat owners, captains and yacht crew, tourists and yacht renters, investors, and media professionals. However, **41 cells (58.6%) had expected counts below 5**, with a **minimum expected count of 0.63**, suggesting uneven distribution among occupation categories, which may affect result reliability. The **Likelihood Ratio test ($\chi^2 = 443.613$, p = 0.000)** supports the significance of this relationship, while the **Linear-by-Linear Association test (1.191, p = 0.275)** indicates that the relationship is **not strictly linear**, meaning that ICT usage patterns do not increase or decrease consistently across occupations. This suggests that **certain roles, such as marina managers or**

yacht owners, may rely more on ICT compared to other groups like tourists or crew members. Given the low expected counts in some categories, **grouping similar occupations or conducting post-hoc analyses** could improve the reliability of the findings. Further analysis incorporating **factors like years of experience and educational level** may provide deeper insights into **ICT adoption trends within the yacht marina sector**.

Table (13) Correlations ICT most used and benefits

Correlations ICT most used and benefits			
		ICT most used	Benefits
ICT most used	Pearson Correlation	1	.042
	Sig. (2-tailed)		.394
	N	408	408
Benefits	Pearson Correlation	.042	1
	Sig. (2-tailed)	.394	
	N	408	408

The Pearson correlation analysis was conducted to examine the relationship between the most used ICT tools in yacht marina management and the perceived benefits of ICT. The results indicate a very weak positive correlation ($r = 0.042$, $p = 0.394$), which is not statistically significant since $p > 0.05$. This suggests that there is no meaningful relationship between the extent to which ICT tools are used in marinas and the perceived benefits of ICT. In other words, the frequency of ICT usage does not necessarily translate into a stronger recognition of its advantages among respondents. This could indicate that while ICT is implemented in yacht marinas, its perceived impact varies based on factors such as effectiveness, user experience, or operational efficiency. Further analysis, such as segmenting data by occupation or experience levels, may provide deeper insights into why some users recognize ICT benefits more than others despite similar usage levels.

5. Conclusion

This study examined the role of technological tools in managing yacht marinas along the Red Sea coast, focusing on the extent of ICT adoption, its benefits, and the challenges associated with implementation. The findings indicate that security and GPS tracking systems are among the most widely used technologies, emphasizing their crucial role in ensuring safety and operational efficiency. Additionally, reservation management systems and automated access control tools have been increasingly integrated into marina operations, enhancing customer service and streamlining processes.

Despite the advantages of ICT adoption, several challenges hinder full-scale implementation, including high initial costs, lack of technical expertise, and resistance to change among staff. The results also suggest that the frequency of ICT usage does not always correlate with a strong perception of its benefits, indicating a need for

better training and awareness programs to maximize the value of digital tools in marina management.

In conclusion, ICT plays a transformative role in modernizing yacht marina operations, yet its effectiveness depends on how well stakeholders understand and utilize these technologies. Addressing the challenges of adoption and ensuring that ICT solutions align with the needs of marina operators and visitors will be crucial in optimizing digital transformation in this sector.

6. Recommendations

1. **Enhancing Digital Literacy and Training Programs**
   - Implement comprehensive training programs for marina staff, yacht owners, and operators to ensure effective utilization of ICT tools.
   - Conduct workshops and knowledge-sharing sessions to improve understanding of marina management software, security systems, and automation technologies.
2. **Encouraging Investment in Cost-Effective ICT Solutions**
   - Provide subsidies or incentives for small and medium-sized marinas to facilitate the adoption of advanced technological systems.
   - Promote the use of cloud-based and AI-driven marina management tools, which offer scalability and lower maintenance costs.
3. **Improving ICT Infrastructure and Security Measures**
   - Strengthen network connectivity and cybersecurity frameworks to ensure the stability and security of digital operations.
   - Encourage the adoption of block chain technology for secure and transparent financial transactions in marina management.
4. **Integrating ICT in Sustainable Marina Management**
   - Expand the use of environmental monitoring systems to track water quality, fuel consumption, and energy efficiency.
   - Encourage the use of smart sensors and IoT solutions to support sustainable and eco-friendly marina operations.
5. **Strengthening Policy Support and Industry Collaboration**
   - Develop clear guidelines and regulations to standardize ICT integration in yacht marinas.
   - Foster collaborations between technology providers, marina operators, and tourism stakeholders to drive innovation and best practices.

By implementing these recommendations, yacht marinas can fully leverage ICT to enhance operational efficiency, improve security, and provide a seamless experience for yacht owners and visitors. Future research should explore emerging technologies like AI, IoT, and automation in marina management to further enhance efficiency and sustainability in the industry.

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الملخص العربي :

تلعب مراسي اليخوت دورًا حاسمًا في صناعة السياحة البحرية، وتتطلب أنظمة إدارة فعّالة لضمان العمليات السلسة وتعزيز الأمن وتحسين تجربة الزائر .وقد أدى دمج تكنولوجيا المعلومات والاتصالات إلى تحويل إدارة المراسي، وتوفير حلول مبتكرة في الأمن وأنظمة الحجز والمراقبة عن بعد .تهدف هذه الدراسة إلى تقييم اعتماد أدوات تكنولوجيا المعلومات والاتصالات في إدارة مراسي اليخوت على طول ساحل البحر الأحمر، مع التركيز على مستوى التنفيذ والفوائد الملموسة والتحديات الرئيسية المتعلقة بالتحول الرقمي .تم توزيع استبيان منظم على 408 من أصحاب المصلحة، بما في ذلك أصحاب اليخوت والقوارب ومديري المراسي والقباطنة وأعضاء الطاقم والمستثمرين ومحترفي السياحة .تكشف النتائج أن أنظمة الأمن وتقنيات تتبع نظام تحديد المواقع العالمي (GPS) هي الأكثر اعتمادًا على نطاق واسع، مما يعكس أولوية للسلامة ومراقبة السفن .ومع ذلك، فإن أدوات إدارة الصيانة والمراقبة البيئية وتحليلات البيانات غير مستغلة بشكل كافٍ، مما يشير إلى وجود فجوة في استخدام التقنيات الذكية للاستدامة طويلة الأجل .في حين تساهم تكنولوجيا المعلومات والاتصالات في تحسين الكفاءة التشغيلية وتجربة العملاء واستراتيجيات التسويق، فإن الحواجز مثل تكاليف التنفيذ المرتفعة ونقص الخبرة الفنية ومقاومة التغيير التكنولوجي تعيق التبني الكامل .خلصت الدراسة إلى أنه في حين أن تكنولوجيا المعلومات والاتصالات لها تأثير تحويلي على عمليات المراسي، إلا أن هناك حاجة إلى المزيد من الاستثمارات في تدريب الموظفين والأمن السيبراني والحلول الفعالة من حيث التكلفة للمراسي الصغيرة .وتشمل التوصيات تحسين الثقافة الرقمية بين موظفي المراسي، ودعم تبني التكنولوجيا للعمليات الأصغر، ودمج أنظمة مراقبة بيئية متقدمة لتعزيز الاستدامة

الكلمات المفتاحية : مراسي اليخوت، تكنولوجيا المعلومات والاتصالات، التحول الرقمي، إدارة المراسي، أنظمة الأمن، الكفاءة التشغيلية

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